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10/710,895	08/11/2004	Boris A. Movchan	13DV-13975-4	4894
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HARTMAN AND HARTMAN, P.C.			SMITH, FRANCIS P	
552 EAST 700 NORTH			ART UNIT	
VALPARAISO, IN 46383			PAPER NUMBER	
			1792	
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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<b>Office Action Summary</b>	<b>Application No.</b> 10/710,895	<b>Applicant(s)</b> MOVCHAN ET AL.	
	<b>Examiner</b> Francis P. Smith	<b>Art Unit</b> 1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 11 August 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-15 and 17-25 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☐ Claim(s) \_\_\_\_\_ is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                     | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## **DETAILED ACTION**

### ***Terminal Disclaimer***

1. The terminal disclaimer filed on July 2, 2008 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of US 7,087,266 B2 has been reviewed and is accepted. The terminal disclaimer has been recorded.

### ***Response to Arguments***

2. Applicant's arguments, filed May 21, 2008, with respect to the rejection(s) of claim(s) 3, 12, 13, 14-19 under 35 USC 103 (a) over Rigney et al. (US 6,492,038) have been fully considered and are persuasive in light of the filed terminal disclaimer. Therefore, the rejection involving Rigney has been withdrawn. The rejection of claim 14 under 35 USC 112, 2nd paragraph, is withdrawn. The rejection of claims 1-25 on the ground of nonstatutory obviousness-type double patenting is withdrawn. Claims 1, 2, 4, 7, 8, 11, 14-19, 21, and 24 are amended and claim 16 is canceled.

Applicants argue that prior art reference to Rigney et al. (US 6,492,038 B1) does not involve sintering. The examiner respectfully disagrees. Rigney teaches substantially the same processing steps as the instant application. Specifically, Rigney teaches heat treating the TBC-coated substrate in the presence of a carbon-containing and/or nitrogen containing gas to form an additional amount of the precipitates. The heat treatment was conducted at temperatures ranging 900-1150°C, and thus, would

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**inherently involve partial sintering** as stated in the instant application (col. 6, lines 4-29; see instant application [0026]).

Applicants argue that prior art reference to Alpertine et al. (US 6,312,832 B1) does not teach a sintering operation to increase the entrapment of carbon-based gasses as a by-product of the metal carbon reaction. The examiner respectfully disagrees. Alpertine specifically teaches a barrier coating whereby carbon is **sintered** with oxides. As carbon dioxide is a well known byproduct of combustion reactions, the sintering of the carbon source will inherently produce a carbon containing gas, which will inherently entrap said gases in the barrier coating. Thus, Alpertine's method is substantially similar to applicants' whereby a carbon containing gas is entrapped within the barrier layer's micropores as a result of carbon reacting with oxygen during a sintering step [0024]. In light of applicants' amendments, new grounds of rejection under 35 USC 102(e), (b), and 103 (a) are outlined below.

### ***Claim Rejections - 35 USC § 102***

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1, 2, 4-11, 15, and 17-25 are rejected under 35 U.S.C. 102(e) as being anticipated by Rigney et al. (US 6,492,038B1).

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

Regarding claim 1, Rigney teaches a thermal barrier coating (TBC) and a method for forming the coating on a component intended for use in a hostile environment. Specifically, the process for forming the TBC entails depositing a suitable TBC material in the presence of a carbon or nitrogen containing gas (i.e. forming the thermal barrier coating of a thermal-insulating material in which is contained elemental carbon and/or a gas that is insoluble in the thermal-insulating material) (col. 5, lines 23-30). The high-temperature evaporation of the TBC material in the presence of the carbon and/or nitrogen-containing gas(es) results in the simultaneous formation of the precipitates (i.e. elemental carbon and/or a gas) at the defects and pores within the grains and at and between the grain boundaries of the TBC microstructure (i.e. elemental carbon and/or insoluble gas being within pores (infiltrating) that are within grains and at and between grain boundaries of the thermal insulating material) (col. 4, lines 51-57; col. 5, lines 45-50). To be effective, it is believed that the TBC must contain at least three volume percent of the precipitates, whereby the proportions of the precipitates can be

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controlled through adjusting the partial pressure of the carbon and/or nitrogen containing gas(es) (i.e. the elemental carbon and/or insoluble gas being present in an amount sufficient to thermally stabilize the microstructure of the thermal insulating material) (col. 5, lines 6-9 and 50-53). Rigney also teaches heat treating the TBC-coated substrate in the presence of a carbon-containing and/or nitrogen containing gas to form an additional amount of the precipitates. The heat treatment was conducted at temperatures ranging 900-1150°C, and thus, would inherently involve partial sintering/forming additional pores that entrap the carbon-containing gas (col. 6, lines 4-29; see instant application [0026]). By sufficiently stabilizing the barrier layer in such a manner, the TBC microstructure can **subsequently** be heated to temperatures in excess of 1200°C (col. 3, lines 23-30).

For claims 2, 11, 15, and 17-19, Rigney teaches high-temperature evaporation of the TBC material in the presence of the carbon and/or nitrogen-containing gas(es) whereby the TBC ingot could be altered to contain carbon, a carbon-containing compound, or a carbide, or a nitride (i.e. co-evaporating carbon and a thermal-insulating material at an elevated temperature) (col. 5, lines 45-50 and 55-58). The heat treatment utilizing a carbon containing gas will inherently form additional pores that entrap the carbon-containing gas and deposit elemental carbon within the pores, grains, and at and between grain boundaries of the thermal-insulating material, the pores establishing and open porosity with the thermal barrier coating. The heat treatment at temperatures of 900-1150°C will inherently cause partial sintering to evolve a carbon containing gas from at least some of the elemental carbon and then close at least some of the pores to

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entrap the carbon-containing gas within the closed pores, the elemental carbon and/or the insoluble gas being present in an amount sufficient to thermally stabilize the microstructure of the thermal-insulating material (i.e. the pores containing the carbon-containing gas are resistant to sintering, grain coarsening, and pore redistribution, as per claim 15) (col. 6, lines 4-20).

Regarding claims 4, 21, and 24, Rigney discloses depositing a thermal barrier coating utilizing EBPVD (i.e. thermal-insulating material), which inherently has a microstructure with pores and sub-grain interfaces within, at and between the grain boundaries of the microstructure, the pores establishing an open porosity within the thermal barrier coating (col. 4, lines 23-26, 51-55). The high-temperature evaporation of the TBC material is conducted in the presence of the carbon and/or nitrogen containing gas at 0.005 mbar (i.e. vacuum infiltrating open porosity of the thermal barrier layer coating with the insoluble gas) (col. 5, lines 45-50). In addition, the TBC coated substrate may be heat treated in the presence of a carbon or nitrogen containing gas at a temperature of 900-1100°C (i.e. heating the thermal barrier coating, which would inherently close at least some of the pores while trapping insoluble gas within the closed pores by partial sintering) (col. 6, lines 4-11).

As per claims 5 and 22, Rigney discloses the use of nitrogen gas, which is an insoluble gas (col. 5, lines 27-30).

Addressing claim 6-8, Rigney teaches stabilization of the TBC microstructure by forming fine precipitates (i.e. carbon or nitrogen insoluble gas) that anchor and pin the grain boundaries and pores of the TBC, thus preventing grain growth and pore

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redistribution from sintering/high temperature usage (i.e. at least some of the pores entrap the insoluble gases) (col. 4, lines 57-65). The high-temperature used during evaporation would inherently cause carbon containing gas to evolve from the elemental carbon prior to the sintering step, closing at least some of the pores. Additionally, the TBC-coated substrate is subject to a heat treatment in the presence of a carbon and/or nitrogen containing gas. Decomposition of preferred precipitates advantageously leave pores when subject to high temperatures of 900-1150°C (i.e. heating the thermal barrier coating to a temperature sufficient to evolve the carbon-containing gas from the elemental carbon and partially sintering the TBC that would inherently trap the carbon containing gas as per claim 7). The heat treatment is conducted at a temperature of 900-1100°C (claim 8) (col. 4, lines 55-67; col. 5, lines 1-5; col. 6, lines 4-20).

As for claim 9, Rigney teaches a TBC containing columnar grains (col. 4, lines 36-37).

Regarding claim 10, Rigney discloses that a preferred insulating material is yttria-stabilized zirconia (col. 4, lines 25-30).

For claims 20 and 25, Rigney teaches a TBC containing columnar grains and a preferred insulating material is yttria-stabilized zirconia (col. 4, lines 25-30 and 36-37).

For claim 23, Rigney teaches depositing the TBC using a physical vapor deposition technique such as electron beam physical vapor deposition (col. 4, lines 23-26).



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5. Claims 1, 2, 4-11, 15, and 17-25 are rejected under 35 U.S.C. 102(b) as being anticipated by Alperine et al. (US 6,312,832 B1).

Regarding claims 1, 4-8, 11, 15, 17-19, 21, 22, and 24, Alperine teaches process for depositing (i.e. forming) a thermal barrier coating whereby an insoluble gas (e.g. CO or CO<sub>2</sub>) is trapped in the crystalline network of the ceramic and in the micro-pores of its structure (i.e. establishing an open porosity within the thermal barrier coating and infiltrating the thermal barrier coating), thereby contributing to reducing thermal conductivity (col. 4, lines 6-20). Additionally, carbon is introduced in small quantities from 0.01-1.0 weight percent to reduce the thermal conductivity of the coating (i.e. depositing elemental carbon in pores that are within grains and at and between grain boundaries of the thermal-insulating material, the pores establishing an open porosity within the thermal barrier coating, the carbon being present in an amount sufficient to thermally stabilize the microstructure of the thermal insulating material) (col. 4, lines 6-20). The process is conducted in an evacuated chamber, which is analogous to vacuum infiltrating the open porosity of the thermal barrier coating with a gas that is insoluble in the thermal-insulating material, as per claim 21 (col. 4, lines 60-64). The coatings undergo a high temperature aging process at a temperature of 1100°C (claim 24) that would inherently close some of the pores, entrapping the CO or CO<sub>2</sub>, insoluble gases as per claims 4-6, 11, 22 (i.e. partially sintering to close some of the pores/heating at a temperature of at least 950°C whereby the pores containing the carbon-containing gas are inherently resistant to sintering, grain coarsening, and pore redistribution, and inherently creating additional pores that entrap the carbon-containing

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gas as per claims 5-8, 11, 15, 17-19) (col. 5, lines 44-51).

As per claim 2, Alperine teaches the co-evaporation of carbon and a thermal-insulating material by EBPVD (i.e. at an elevated temperature to deposit the elemental carbon within the pores) that thermally stabilizes the pores (col. 4, lines 15-20 and 42-68; col. 6, lines 11-38).

For claims 9, 10, 20, and 25, Alperine discloses a thermal barrier coating comprising columnar grains (col. 5, lines 15-18). Furthermore, the thermal-insulating material is composed of yttrium and zirconia (i.e. yttria-stabilized zirconia) (col. 3, lines 3-10; see example 2, col. 6).

As per claim 23, Alperine teaches depositing by electron beam physical vapor deposition (col. 4, lines 35-40).

### ***Claim Rejections - 35 USC § 103***

6. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

7. Claims 3 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Alperine (US6 6,312,832 B1) in view of Strangman et al. (US 6,482,537).

Alperine teaches a simultaneous evaporation of the thermal-insulating material and the carbon-containing material (col. 6, lines 15-29). However, Alperine does not teach the use separate ingots.

Strangman teaches an improved electron beam-physical vapor deposition process that utilizes two separate ingots. The two ingots are spaced apart and

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separated by a baffle. The ingots are bombarded with a stream of electrons (i.e. simultaneously evaporated) while the component is then alternately exposed to vapor deposition from the two vapor streams by the rotation of the surfaces to be coated (col. 2, lines 25-34). Therefore, it would have been obvious to one skilled in the art at the time of the invention to modify Alperine's method by supplying the thermal-insulating material and carbon-containing material in separate ingots as taught by Strangman in order to create distinguished layers of ceramic material whereby each individual ceramic layer containing nitride may be partially carburized to enhance the integrity of the thermal barrier coat.

8. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Alperine (US6 6,312,832 B1) in view of Strangman et al. (US 6,482,537), as applied to claim 12 above, and further in view of Turpin et al. (US 6,238,594 B1).

Alperine as modified by Strangman does not teach using graphite.

Turpin teaches the use and method of making an intumescent material that contains expandable graphite for use in coatings or films. Specifically, the expandable particulate graphite expands from about 20-200 times its unexpanded volume to fill voids and cavities (col. 2, lines 35-52). Therefore, it would have been obvious to one skilled in the art at the time of the invention to include Turpin's expandable graphite in Alperine/Strangman's second ingot in order to effectively fill the pores/voids of the thermal barrier coat and to reduce the corrosion of aluminum found in TBC's.

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9. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Alperine et al. (US 6,312,832) as applied to claim 11 above, in view of Maloney (US 6,299,971 B1).

Alperine does not disclose establishing an open porosity within the thermal barrier coating of at least 25 volume percent of the thermal barrier coating.

Maloney teaches methods for producing layered ceramic coatings in which some layers contain porosity. Specifically, the porous layer will contain substantially more than about 20% porosity by volume after a heat treatment (col. 4, lines 30-32).

Therefore, it would have been obvious to one skilled in the art at the time of the invention for Alperine's low thermal conductivity heat barrier coating to contain an open porosity of at least 25 volume percent by incorporating Maloney's heat treatment in order to enhance the mechanical properties of the coating by densifying the ceramic in the regions between the pores.

### ***Conclusion***

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within

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TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Francis P. Smith whose telephone number is (571) 270-3717. The examiner can normally be reached on Monday through Thursday 7:00 AM-5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mikhail Kornakov can be reached on (571) 272-1303. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/F. P. S./

Examiner, Art Unit 1792

/Michael Kornakov/

Supervisory Patent Examiner, Art Unit 1792